AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (cancelled).

2. (previously presented): A magnetoresistance device comprising:

a magnetoresistance element including:

a free ferromagnetic layer having reversible spontaneous magnetization,

a fixed ferromagnetic layer having fixed spontaneous magnetization, and

a tunnel dielectric layer disposed between said free and fixed ferroelectric layer;

a non-magnetic conductor providing electrical connection between said magnetoresistance element to another element; and

a diffusion barrier structure disposed between said conductor and said magnetoresistance element, wherein said diffusion barrier structure is formed of material selected from the group consisting of MgO_x, CaO_x, LiO_x, and HfO_x.

3. (previously presented): A magnetoresistance device comprising

a magnetoresistance element including:

a free ferromagnetic layer having reversible spontaneous magnetization,

a fixed ferromagnetic layer having fixed spontaneous magnetization, and

a tunnel dielectric layer disposed between said free and fixed ferroelectric layer;

a non-magnetic conductor providing electrical connection between said magnetoresistance element to another element; and

a diffusion barrier structure disposed between said conductor and said magnetoresistance element, wherein said diffusion barrier structure is made of oxynitride of one or more elements having free energies of oxide and nitride formations less than those of elements included in layers connected on top and bottom surfaces of said diffusion barrier structure.

4. (previously presented): The magnetoresistance device according to claim 3, wherein said diffusion barrier structure is made of material selected from the group consisting of TiNO and HfNO.

Claims 5-14 (canceled).

15. (withdrawn): The magnetoresistance device according to claim 1, wherein said conductor includes:

a first conductor electrically connected to said fixed ferromagnetic layer without involving said tunnel dielectric layer, and

a second conductor electrically connected to said free ferromagnetic layer without involving said tunnel dielectric layer, and

wherein said diffusion barrier structure includes:

a first diffusion barrier layer disposed between said first conductor and said fixed ferromagnetic layer, and

a second diffusion barrier layer disposed between said second conductor and said free ferromagnetic layer.

16. (withdrawn): The magnetoresistance device according to claim 15, wherein said first and second diffusion barrier layers are made of material selected from the group consisting of oxides, nitrides, and oxynitrides.

17. (withdrawn): The magnetoresistance device according to claim 1, wherein said diffusion barrier structure is disposed between a layer including manganese and said conductor or between a layer including nickel and said conductor.

18. (withdrawn): The magnetoresistance device according to claim 1, wherein said conductor includes a first conductor electrically connected to said fixed ferromagnetic layer without involving said tunnel dielectric layer,

wherein said diffusion barrier structure includes a first diffusion barrier layer connected between said first conductor and said fixed ferromagnetic layer, and

wherein said magnetoresistance element further includes a manganese-including antiferromagnetic layer, and

wherein said antiferromagnetic layer is positioned between said fixed ferromagnetic layer and said first diffusion barrier layer.

19. (withdrawn): The magnetoresistance device according to claim 18, wherein said fixed ferromagnetic layer comprises:

a ferromagnetic layer directly contacted with said tunnel dielectric layer, and

a composite magnetic layer disposed between said ferromagnetic layer and said antiferromagnetic layer, and

wherein said composite magnet layer is made of mixture including non-oxidized metal ferromagnetic material as main material, and oxide material as sub material, said oxide material being oxide of non-magnetic element more reactive to oxygen than said metal ferromagnetic material.

20. (withdrawn): The magnetoresistance device according to claim 19, wherein said ferromagnetic layer and said metal ferromagnetic material included in said composite magnetic layer is made of a metal ferromagnetic alloy including cobalt as main material.

21. (withdrawn): The magnetoresistance device according to claim 1, wherein said free ferromagnetic layer comprises:

a ferromagnetic layer directly contacted with said tunnel dielectric layer, and

a composite magnetic layer made of mixture including non-oxidized metal ferromagnetic material as main material, and oxide material as sub material, said oxide material being oxide of non-magnetic element more reactive to oxygen than said metal ferromagnetic material.

22. (withdrawn): The magnetoresistance device according to claim 21, wherein said ferromagnetic layer and said metal ferromagnetic material included in said composite magnetic layer is made of a metal ferromagnetic alloy including cobalt as main material.

23. (withdrawn): The magnetoresistance device according to claim 1, wherein said conductor includes a second conductor electrically connected to said free ferromagnetic layer without involving said tunnel dielectric layer, and

wherein said diffusion barrier structure includes a second barrier layer disposed between said free ferromagnetic layer and said second conductor.

24. (withdrawn): The magnetoresistance device according to claim 23, wherein said second diffusion barrier layer is directly contacted with said free ferromagnetic layer, and said free ferromagnetic layer has a thickness less than 3 nm.

25. (withdrawn): The magnetoresistance device according to claim 24, wherein a produce of a saturation magnetization and a thickness of said free ferromagnetic layer is less than 3 (T•nm).

26. (withdrawn): The magnetoresistance device according to claim 23, wherein said free ferromagnetic layer comprises a nickel-containing ferromagnetic layer including nickel, and said second diffusion barrier layer is directly contacted with said nickel-containing ferromagnetic layer.

27. (withdrawn): The magnetoresistance device according to claim 23, wherein said free ferromagnetic layer comprises:

a ferromagnetic layer directly contacted with said tunnel dielectric layer, and

a magnetization control structure connected to said ferromagnetic layer, said magnetization control structure including non-magnetic material and ferromagnetic material included in said ferromagnetic layer.

28. (withdrawn): The magnetoresistance device according to claim 27, wherein said magnetization control structure is non-magnetic.

29. (withdrawn): The magnetoresistance device according to claim 27, wherein said magnetization control structure is made of oxide or nitride of ferromagnetic material included in said ferromagnetic layer.

30. (withdrawn): The magnetoresistance device according to claim 27, wherein said non-magnetic material is formed of at least one element selected from the group consisting of Ru, Pt, Hf, Pd, Al, W, Ti, Cr, Si, Zr, Cu, Zn, Nb, V, Cr, Mg, Ta, and Mo.

31. (withdrawn): The magnetoresistance device according to claim 27, wherein said non-magnetic material is segregated on grain boundary of crystals of said ferromagnetic material.

32. (withdrawn): The magnetoresistance device according to claim 23, wherein said free ferromagnetic layer is formed so that axes of easy magnetization of stress-induced and shape-induced magnetic anisotropies are directed in a same direction.

33. (withdrawn): The magnetoresistance device according to claim 32, wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in a first direction,

wherein a magnetostriction constant of said free ferromagnetic layer is positive, and

wherein a compressive stress is exerted on said free ferromagnetic layer in a second direction orthogonal to said first direction.

34. (withdrawn): The magnetoresistance device according to claim 32, wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in a first direction,

wherein a magnetostriction constant of said free ferromagnetic layer is positive, and

wherein a tensile stress is exerted on said free ferromagnetic layer in said first direction.

35. (withdrawn): The magnetoresistance device according to claim 32, wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in a first direction,

wherein a magnetostriction constant of said free ferromagnetic layer is negative, and

wherein a compressive stress is exerted on said free ferromagnetic layer in said first direction.

36. (withdrawn): The magnetoresistance device according to claim 32, wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in a first direction,

wherein a magnetostriction constant of said free ferromagnetic layer is negative, and

wherein a tensile stress is exerted on said free ferromagnetic layer in a second direction orthogonal to said first direction.

37. (withdrawn): The magnetoresistance device according to claim 32, further comprising:

a substrate; and

a lower interconnection disposed to extend in a first direction between said substrate and said free ferromagnetic layer,

wherein a magnetostriction constant of said free ferromagnetic layer is positive, and

wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in said first direction.

38. (withdrawn): The magnetoresistance device according to claim 32, wherein said further comprising:

a substrate; and

a lower interconnection disposed to extend in a second direction between said substrate and said free ferromagnetic layer,

wherein a magnetostriction constant of said free ferromagnetic layer is negative, and

wherein a contact interface between said free ferroelectric layer and said tunnel dielectric layer is shaped to extend in a first direction orthogonal to said second direction.

39. (withdrawn): The magnetoresistance device according to claim 22, wherein stress-induced magnetic anisotropy of said free ferromagnetic layer is stronger than shape-induced magnetic anisotropy of said free ferromagnetic layer.

40. (withdrawn): The magnetoresistance device according to claim 39, wherein said free ferromagnetic layer has a major axis and a minor axis perpendicular to said major axis, and

an aspect ratio, defined as being a ratio of said major axis to said minor axis, is equal to or more than 1.0, and is equal to or less than 2.0.

41. (withdrawn): The magnetoresistance device according to claim 23, wherein said free ferromagnetic layer comprises:

a first ferromagnetic layer directly contacted with said tunnel dielectric layer,

a composite magnetic layer connected to said first ferromagnetic layer, and made of mixture including non-oxidized metal ferromagnetic material as main material, and oxide material as sub material, said oxide material being oxide of non-magnetic element more reactive to oxygen than said metal ferromagnetic material,

a second ferromagnetic layer including nickel, and connected to said composite magnetic layer, said second ferromagnetic layer being magnetically softer than said composite magnetic layer and said first ferromagnetic layer.

42. (withdrawn): The magnetoresistance device according to claim 40, wherein said first ferromagnetic layer and metal ferromagnetic material included in said composite magnetic layer are made of metal ferromagnetic alloy mainly containing cobalt.

43. (withdrawn): The magnetoresistance device according to claim 1, wherein said free ferromagnetic layer comprises:

a first ferromagnetic layer directly contacted with said tunnel dielectric layer,

a first composite magnetic layer made of mixture including non-oxidized metal ferromagnetic material as main material and oxide material as sub material, said oxide material being oxide of non-magnetic element more reactive to oxygen than said metal ferromagnetic material,

a second composite magnetic layer made of mixture including non-oxidized metal ferromagnetic material as main material and oxide material as sub material, said oxide material being oxide of non-magnetic element more reactive to oxygen than said metal ferromagnetic material,

a non-magnetic layer disposed between said first and second composite magnetic layers to achieve antiferromagnetic coupling between said first and second composite magnetic layers.

44. (withdrawn): The magnetoresistance device according to claim 43, wherein said first ferromagnetic layer, said metal ferromagnetic material included in said first composite magnetic layer and metal ferromagnetic material included in said second composite magnetic layer are made of metal ferromagnetic alloy mainly containing cobalt.

45. (withdrawn): The magnetoresistance device according to claim 1, wherein said conductor includes a second conductor electrically connected to said free ferromagnetic layer without involving said tunnel dielectric,

wherein said magnetoresistance element further includes a magnetic biasing element providing a bias magnetic field for said free ferromagnetic layer,

wherein said magnetic bias element includes comprises:

a magnetic bias ferromagnetic layer, and

a magnetic bias antiferromagnetic layer including manganese and connected to said magnetic biasing ferromagnetic layer, and

wherein said oxide layer includes:

a first oxide layer disposed between said magnetic biasing element and said free ferromagnetic layer, and

a second oxide layer disposed between said magnetic biasing element and said second conductor.

46. (withdrawn): A magnetoresistance device fabrication method comprising:

a step of forming a fixed ferromagnetic layer,

a step of forming a tunnel dielectric layer connected to said fixed ferromagnetic layer

a step of forming a first ferromagnetic layer on a contact surface on an opposite side of said fixed ferromagnetic layer,

a step of modifying an opposite portion of said first ferromagnetic layer, said portion being positioned on an opposite side of said contact surface.

47. (withdrawn): The magnetoresistance device fabrication method according to claim 46, wherein said opposite portion is modified to be non-magnetic.

48. (withdrawn): The magnetoresistance device fabrication method according to claim 46, wherein said step of modifying includes:

a step of nitrizing or oxidizing said opposite portion.

49. (withdrawn): The magnetoresistance device fabrication method according to claim 46, wherein said step of modifying includes:

a step of forming a non-magnetic metal layer made of non-magnetic metal on an opposite surface out of surfaces of said first ferromagnetic layer, said opposite surface is positioned on an opposite side of said contact surface, and

a step of achieving inter-diffusion between said first ferroelectric layer and said non-magnetic metal layer.

50. (withdrawn): The magnetoresistance device fabrication method according to claim 49, wherein said material includes nickel.